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**Forest Pest
Management**

Davis, CA.

Data Report of Wind Tunnel Tests D8-45 Nozzle Atomizing Glycerine and Water at Air Velocities 50 and 60 MPH

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DATA REPORT OF WIND TUNNEL TESTS -

D8-45 NOZZLE ATOMIZING GLYCERIN AND WATER AT AIR VELOCITIES 50 AND 60 MPH

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Introduction

This wind tunnel test was conducted in support of Program WIND. A sub-study of Program WIND designated EMCOT (Event Model for Complex Terrain) tested a hypothesis that the optimum atmospheric conditions for pesticide application could be predicted by monitoring temperature and winds.

To test the hypothesis, Bob Ekblad, engineer assigned to the Missoula Equipment Development Center, conducted a series of aerial spray trials. The computer base model used in the study required as input the droplet spectrum of the tank mix applied by the Bell 206 helicotper.

The droplet spectrum was obtained in a wind tunnel using a laser to measure the drops as they were atomized by the nozzle.

Method

The tests were conducted in a wind tunnel with a test section 8 feet long and a 2 x 2 foot cross section. Particles are sized by measuring the amount of light scattered into the collecting optics by particles interacting through a focused laser beam. The laser system was an OAP-2D-GA1 imaging probe which counts and classifies the drops into 62 size classes from 30 to 2062 μm.

A D8-45 hollow-cone nozzle directed 0 degrees relative to the airstream was tested at 50 mph and 60 mph and pressure of 40 psi.

The nomenclature used is as follows:

$D_{V.1}$ = Diameter that contains 10% of volume in drops of smaller size.

$D_{V.5}$ = Diameter that contains 50% of volume in drops of smaller size. (Volume median diameter)

$D_{V.9}$ = Diameter that contains 90% of volume in drops of smaller size.

$$\text{Relative Span} = \text{R.S.} = \frac{D_{V.9} - D_{V.1}}{D_{V.5}}$$

Results

Results are given in Tables 1 and Figure 1 for the 50 mph velocity and in Tables 2 and Figure 2 for the 60 mph velocity. There was no detectable difference in the drop size spectrum between the two velocities.

Table 1 - Drop Size Data, D8-45, 50 MPH, .88 GPM

Nozzle	D8-45	Slice Rate	2 MHz
Angle to Airstream	0 degrees	AVG	100
Spray Pressure	40 psi	DFM	1 cm.
Airspeed	50 mph	BAR	1.5
Flow Rate	.88 gpm	Distance to Probe	31 cm.
Tank Mix	33.3% GLYCERINE	Sample Interval	300 sec.
	66.6% WATER	Number of Samples	1
		Number of Scans	8
FILE: C:\PMS\DATA\05098614.001		Scan Spacing	6 cm.
Number of Tests Combined: 2		Scan Length	40 cm.

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	3376	1.35E+07	0.44	52.28	0.54	52.28	0.54
89	5418	2.92E+06	0.58	11.31	0.70	63.59	1.24
122	5203	2.48E+06	1.50	9.57	1.82	73.17	3.06
154	4536	2.06E+06	2.82	7.96	3.41	81.12	6.47
187	2826	1.25E+06	3.24	4.84	3.92	85.96	10.40
220	1768	836715	3.66	3.24	4.43	89.20	14.83
252	1215	618695	4.22	2.39	5.11	91.59	19.94
284	865	475469	4.78	1.84	5.79	93.43	25.72
318	724	417476	6.00	1.61	7.27	95.04	32.99
351	574	323632	6.33	1.25	7.67	96.30	40.66
382	437	237844	6.07	0.92	7.36	97.22	48.02
414	380	213973	7.04	0.83	8.53	98.04	56.55
447	288	156021	6.50	0.60	7.88	98.65	64.43
479	202	100298	5.20	0.39	6.30	99.03	70.73
512	132	69685	4.43	0.27	5.36	99.30	76.09
545	109	57107	4.40	0.22	5.33	99.52	81.42
578	81	47832	4.42	0.18	5.35	99.71	86.77
611	47	23446	2.57	0.09	3.11	99.80	89.88
644	44	21846	2.82	0.08	3.41	99.88	93.29
677	20	9121	1.37	0.04	1.66	99.92	94.96
710	17	7685	1.34	0.03	1.62	99.95	96.58
743	10	8861	1.77	0.03	2.15	99.98	98.72
776	3	1513	0.35	0.01	0.42	99.99	99.14
809	1	2389	0.62	0.01	0.75	100.00	99.90
842	1	293	0.09	0.00	0.10	100.00	100.00
TOTAL	2.83E+04	2.59E+07	82.55				

Table 1 - Cont.

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 282777/ 34690 = 81.5%

NUMBER MEAN DIA.= D_{10}.... 100.90 µm
VOLUME MEAN DIA.= D_{30}.... 182.76 µm
SAUTER MEAN DIA.= D_{32}.... 308.06 µm

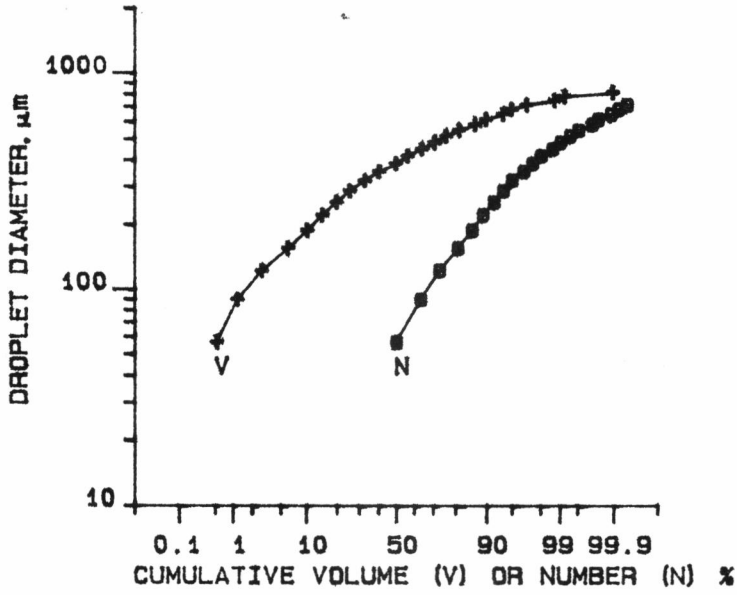
NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 230.57 µm

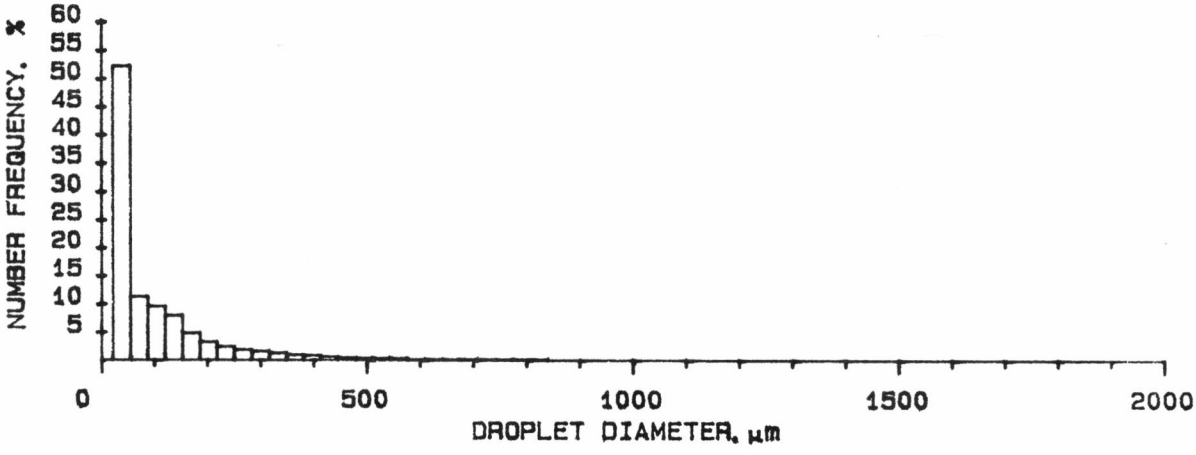
VOLUME MEDIAN DIA.= $D_{V.1}$... 183.97 µm
$D_{V.5}$... 389.66 µm
$D_{V.9}$... 611.63 µm

RELATIVE SPAN= 1.10

Figure 1 - Drop Size and Mass Data Graphs, D8-45, 50 MPH, .88 GPM

Nozzle Type . . . D8-45
Angle to Airstream 0°
Spray Pressure . . 40 psi
Airspeed . . . . . 50 mph
Flow Rate . . . . . .88 gpm
Tank Mix: 33.3% GLYCERINE
66.6% WATER
FILE: C:\PMS\DATA\05098614.001





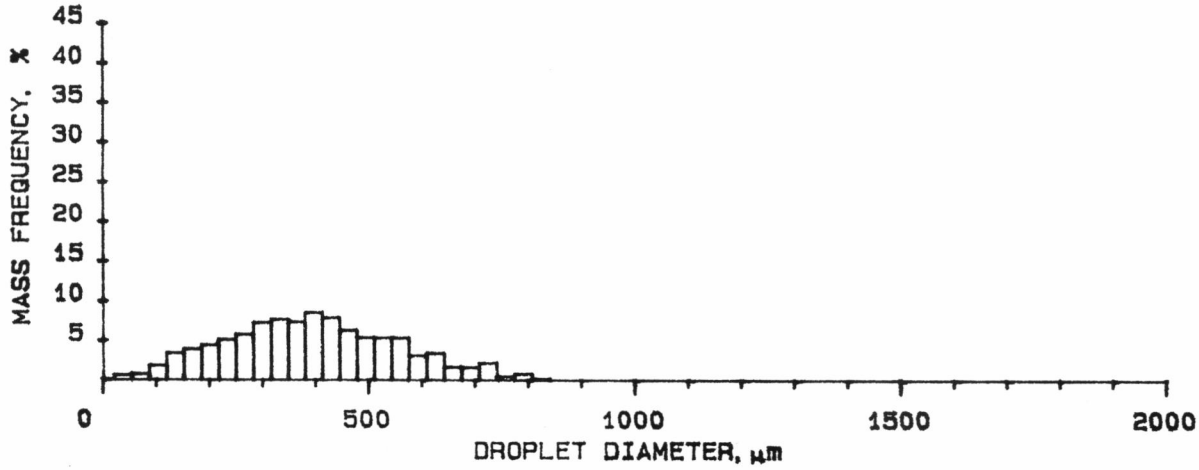


Table 2 - Drop Size Data, D8-45, 60 MPH, .88 GPM

Nozzle	D8-45	Slice Rate	2 MHz
Angle to Airstream	0 degrees	AVG	100
Spray Pressure	40 psi	DFM	1 cm.
Airspeed	60 mph	BAR	1.5
Flow Rate	.88 gpm	Distance to Probe	31 cm.
Tank Mix	33.3% GLYCERINE	Sample Interval	300 sec.
	66.6% WATER	Number of Samples	1
		Number of Scans	8
FILE: C:\PMS\DATA\05098614.002		Scan Spacing	6 cm.
Number of Tests Combined: 2		Scan Length	40 cm.

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	2951	1.26E+07	0.41	51.94	0.50	51.94	0.50
89	4865	2.74E+06	0.55	11.31	0.66	63.25	1.16
122	4475	2.18E+06	1.33	9.00	1.60	72.25	2.76
154	3799	1.83E+06	2.51	7.55	3.02	79.80	5.78
187	2503	1.21E+06	3.13	4.98	3.77	84.78	9.56
220	1717	854062	3.74	3.52	4.51	88.30	14.07
252	1179	622001	4.24	2.56	5.12	90.86	19.18
284	925	514711	5.17	2.12	6.24	92.98	25.42
318	697	377706	5.43	1.56	6.55	94.54	31.98
351	614	338413	6.62	1.40	7.99	95.93	39.97
382	497	273723	6.99	1.13	8.44	97.06	48.40
414	378	203236	6.69	0.84	8.08	97.90	56.48
447	274	150426	6.27	0.62	7.57	98.52	64.04
479	209	103274	5.35	0.43	6.46	98.95	70.51
512	155	70771	4.50	0.29	5.43	99.24	75.94
545	128	64704	4.98	0.27	6.01	99.50	81.95
578	75	40221	3.71	0.17	4.48	99.67	86.43
611	67	31154	3.41	0.13	4.12	99.80	90.55
644	43	20818	2.68	0.09	3.24	99.88	93.79
677	23	8406	1.26	0.03	1.53	99.92	95.32
710	22	8808	1.53	0.04	1.85	99.96	97.17
743	10	8374	1.68	0.03	2.02	99.99	99.19
776	5	1649	0.38	0.01	0.46	100.00	99.65
809	0	0	0.00	0.00	0.00	100.00	99.65
842	0	0	0.00	0.00	0.00	100.00	99.65
875	2	886	0.29	0.00	0.35	100.00	100.00
TOTAL	2.56E+04	2.43E+07	82.85				

Table 2 - Cont.

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 25613/ 32000 = 80.0%

NUMBER MEAN DIA.=	D_{10}	103.41	µm
VOLUME MEAN DIA.=	D_{30}	186.91	µm
SAUTER MEAN DIA.=	D_{32}	312.49	µm
NUMBER MEDIAN DIA.=	$D_{N.1}$	<56	µm
	$D_{N.5}$	<56	µm
	$D_{N.9}$	241.43	µm
VOLUME MEDIAN DIA.=	$D_{V.1}$	190.14	µm
	$D_{V.5}$	388.53	µm
	$D_{V.9}$	606.07	µm

RELATIVE SPAN= 1.07

Figure 2 - Drop Size and Mass Data Graphs, D8-45, 60 MPH, .88 GPM

Nozzle Type . . . D8-45
Angle to Airstream 0°
Spray Pressure . . 40 psi
Airspeed . . . . . 60 mph
Flow Rate . . . . .88 gpm
Tank Mix: 33.3% GLYCERINE
66.6% WATER
FILE: C:\PMS\DATA\05098614.002